Claims

[c1] 1. A method for reconstruction for use in a parallel MRI system wherein a plurality of MR detector coils are arranged in an array and each coil has a corresponding spatial sensitivity profile, the method comprising:
detecting a plurality of gradient-encoded MR signals from the plurality of MR detector coils; and,
processing the detected MR signals with at least one filter bank to reconstruct at least one image.

[c2] 2. The method of claim 1 wherein the plurality of MR detector coils comprises a spatial filter bank formed with the respective sensitivity profiles for spatially filtering the plurality of detected MR signals.

[c3] 3. The method of claim 2 wherein the detector coils are arranged to optimize the spatial encoding of the spatial filter bank.

[c4] 4. The method of claim 1 wherein the detecting step involves collecting a decimated plurality of gradient-encoded MR signals to generate a plurality of decimated signals, and the processing step comprises the steps of;
interpolating the plurality of decimated signals to generate a plurality of interpolated signals; and,
applying at least one of a lapped transform and a synthesis filter bank to reconstruct interpolated signals .

[c5] 5. The method of claim 4 wherein the decimated gradient encoding consists of reduced phase encoding steps.

[c6] 6. The method of claim 4 wherein the decimated gradient encoding consists of collecting sparse subsets of non-rectilinear trajectories in k space, the subsets comprising at least one of a reduced number of interleaves of an interleaved-spiral trajectory and a reduced number of radial lines of a radial trajectory.

[c7] 7. The method of claim 4 further comprising an intermediate filtering step of applying an intermediate filter bank between the decimated gradient encoding and interpolating steps for stabilizing the processing step for reconstructing the at least one image.

[c8] 8.The method of claim 7 wherein the filter bank and the intermediate filter bank satisfies an equation in accordance with

$G(z)^T = \begin{pmatrix} z^{-d} & 0 & \cdots & 0 \end{pmatrix} F_a^{-1}(z) V^{-1}(z^M)$, wherein G(z) represents a synthesis filter bank $F_a(z)$ is an aliasing component matrix of the sensitivity profiles F, z^{-d} is a time delay, V is an additional filter bank inserted between the decimation stage and the interpolation stage for stability and M is a decimation factor.

[c9] 9. The method of claim 1 wherein the at least one image is substantially free of aliasing and amplitude distortion

[c10] 10. The method of claim 1 wherein the sensitivity profiles of the array are overlapping and further comprising the step of applying a lapped transform to the detected signals during the processing step.

[c11] 11. The method of claim 1 wherein the array is a strip array comprised of a plurality of array elements each element being a linear strip.

[c12] 12. The method of claim 1 wherein the array comprises a strip array of a plurality of conductive strips, each strip having a corresponding phase relationship to a spatial location within an object to be imaged in the MRI system and the processing step comprises encoding each of the corresponding phases to reconstruct the at least one image.

[c13] 13. A parallel Magnetic Resonance Imaging (MRI) system comprising:
an array of magnetic resonance (MR) detector coils arranged in an array for detecting a plurality of MR signals, each of the coils having a corresponding spatial sensitivity profile;
a processing means for processing the plurality of MR signals with at least one filter bank to reconstruct at least one image.

[c14] 14. The parallel MRI system of claim 13 wherein the array of MR detector coils comprises a spatial filter bank formed with the respective sensitivity profiles for spatially filtering the plurality of detected MR signals.

[c15] 15. The method of claim 14 wherein the detector coils are arranged to optimize the spatial encoding of the spatial filter bank.

[c16] 16. The parallel MRI system of claim 13, further comprising
a decimated gradient encoding system to generate a plurality of the decimated MR signals; and,
an interpolating system for interpolating the plurality of decimated signals to generate a plurality of interpolated signals; and
at least one of a lapped transform and a synthesis filter bank to reconstruct interpolated signals .

[c17] 17. The parallel MRI system of claim 16 wherein the decimated gradient encoding system comprises reduced phase encoding steps.

[c18] 18. The parallel MRI system of claim 17 wherein the decimated gradient encoding comprises collecting subsets of non-rectilinear trajectories in k space, the subsets including at least one k space, the subsets including at least one of a reduced number of interleaves of an interleaved-spiral trajectory and a reduced number of radial lines of a radial trajectory.

[c19] 19. The parallel MRI system of claim 13 further comprising:
an intermediate filter coupled between the decimated gradient encoding and the interpolating system, the intermediate filter stabilizing the processing means for reconstructing the at least one image.

[c20] 20. The parallel MRI system of claim 19 wherein the filter bank and the intermediate filter bank satisfies an equation in accordance with
$G(z)^T = \begin{pmatrix} z^{-d} & 0 & \cdots & 0 \end{pmatrix} F_a^{-1}(z) V^{-1}(z^M)$, wherein G(z) represents a synthesis filter bank, $F_a(z)$ is an aliasing component matrix of the sensitivity profiles F, z^{-d} is a time delay, V is an additional filter bank inserted between the decimation stage and the interpolation stage for stability and M is a decimation factor.

[c21] 21. The parallel MRI system of claim 13 wherein the at least one image is substantially free of aliasing and amplitude distortion.

[c22] 22. The parallel MRI system of claim 13 wherein the sensitivity profiles of the array are overlapping and further comprising the step of applying a lapped transform to the detected signals during the processing step.

[c23] 23. The parallel MRI system of claim 13 wherein the array is a strip array comprised of parallel strips of conducting material connected to a ground plane by capacitors.

[c24] 24. The parallel MRI system of claim 13 wherein the array comprises a strip array of a plurality of conductive strips, each strip having a corresponding phase relationship to a spatial location within an object to be imaged in the MRI system and the processing step comprises encoding each of the corresponding phases to reconstruct the at least one image.